Combining LLMs and Mathematical Optimization for Manufacturing System Configuration

András Kovács

HUN-REN Institute for Computer Science and Control (SZTAKI)

andras.kovacs@sztaki.hu

Configuring and re-configuring manufacturing systems is a complex engineering optimization problem that requires satisfying hard constraints and preferences, constructing close-to-optimal solutions according to multiple contradictory criteria, as well as accommodating a wide range of practical, application-specific requirements from various stakeholders. Although advanced optimization and decision support tools are available to help engineers solve this problem, encoding the intricate requirements into the given optimization model is still a challenging, inherently iterative and time-consuming process. This talk presents an approach for leveraging large language models (LLMs) to support this process by translating engineers' natural-language queries into structured input for the optimization engine. The approach decomposes input parameter generation into small, loosely coupled sub-problems addressing different aspects of the overall optimization problem, converting them into tractable, often simple classification problems for the LLM. The approach has been validated in real manufacturing environments, including automotive inverter and EV battery assembly, where it achieved robust performance in capturing the user intent and translating it into structured data, achieving over 99% accuracy in individual parameter extraction and more than 80% accuracy across complete configuration scenarios.